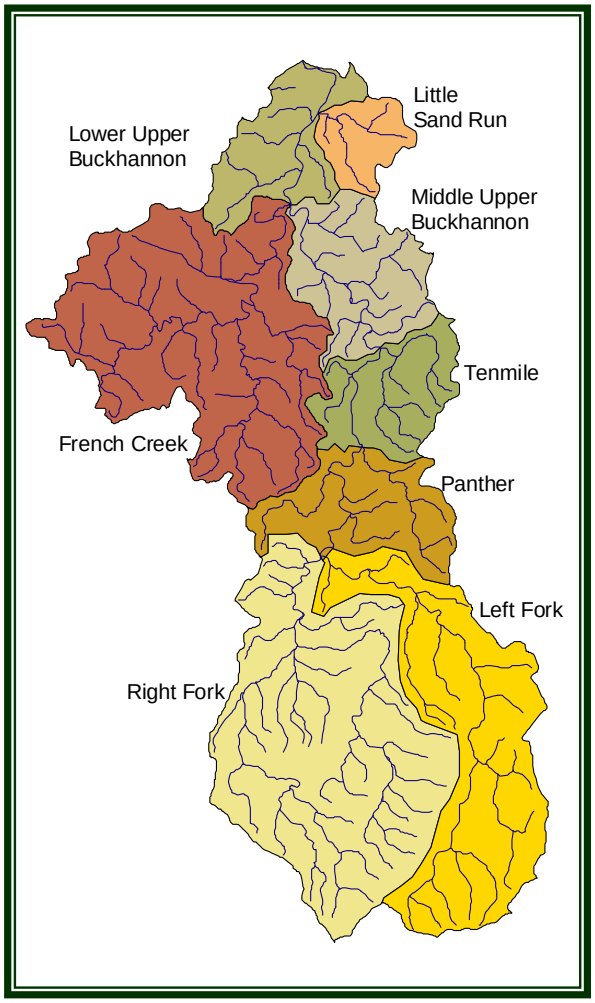
WATERSHED-BASED PLAN FOR THE IMPLEMENTATION OF THE UPPER BUCKHANNON TMDL



Prepared by:

The Highlands Institute for
Environmental Research and Education

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Introduction

The Upper Buckhannon River Watershed consists of approximately 127,600 acres and is located in north-central West Virginia. It is a subwatershed of the Tygart Valley River Watershed and includes most of Upshur County and parts of Barbour, Lewis, Webster, Harrison and Randolph counties (Figure 1). There are 322 stream miles in the watershed.

The four dominant water quality problems within the watershed are metals, pH/acidity, sediment, and fecal bacteria. The main sources of these contaminants are coal mining, acid precipitation, agriculture, road construction and use, logging, and wastewater.

This plan will elucidate the sources of contamination and describe the steps that will need to be taken to achieve load reductions in metals, sediment, and fecal bacteria due to non-point sources; permitted sources of pollution will not be addressed. This report was prepared by The Highlands Institute for Environmental Research and Education at West Virginia Wesleyan College for the Buckhannon Framework Steering Committee and the WV Department of Environmental Protection.

A. Causes and Sources of Non-Point Source Pollution

A.1 Geographical Extent

The Upper Buckhannon River rises near Parting Springs, four miles southeast of Pickens in Randolph County at an elevation of 3,450 feet. It flows northward through Upshur County to Buckhannon where it joins with Fink Run at an elevation of 1,390 feet. This stream is rough and turbulent from its source to Hampton, a few miles upstream from Buckhannon. From Hampton to the mouth of Fink Run the stream is placid and smooth, approaching a base level condition because of a 6-foot dam located about 0.5 miles before Fink Run. This impoundment serves as the water supply for the City of Buckhannon and a large portion of Upshur County.

Major tributaries of the Upper Buckhannon River are Tenmile Creek, Panther Fork, Little Sand Run, French Creek, Left Fork of Buckhannon and Right Fork of Buckhannon. The mean annual precipitation of this watershed is approximately 44 inches.

The Upper Buckhannon River watershed has a total population of 12,225. Buckhannon, located at the northern end of the watershed is the only major population center in the watershed with a population of approximately 6,000. Hampton, Adrian, Alton and Pickens are small towns located upstream from Buckhannon. West Virginia Routes 20 and 4 pass through the watershed from south to north. They cross Route 33 at Buckhannon (Figure 1).

The Upper Buckhannon River Watershed has a low population density. Land uses consist largely of deciduous and mixed forests, with pasture land coming in second. More details can be found in Table 1. For the purposes of this report the Upper Buckhannon Watershed was divided into eight subwatersheds: Lower Upper Buckhannon, Little Sand Run, Middle Upper Buckhannon, Tenmile, Panther, French Creek, Right Fork, and Left Fork (Figure 2).

Table 1. Land use in the Upper Buckhannon River Watershed (WV DEP 2000).

LAND USE	**ACRES**	**(%)**
Forested		
Private	93,614	73.3
Public	1,100	0.9
Agricultural	26,686	20.9
Urban, Commercial, Industry	2,412	1.9
Water Surface and Wetlands	678	0.5
Roads	767	0.6
Mining	1,000	0.8
Other Non-Agricultural	1,366	1.1
TOTAL	**127,623**	**100.0**

Table 2. Subwatershed names, areas, and stream miles for the Upper Buckhannon River Watershed based on 2003 GIS DRG maps (see Figure 2).

Subwatershed Name	**Area** *(acres)*	**Stream Miles** *(mi)*
Little Sand	7,888	8.0
Lower	3,727	**17.8**
Middle	10,047	29.7
French	31,264	80.1
Tenmile	7,817	20.6
Panther	9,542	24.5
Right Fork	34,512	90.6
Left Fork	22,826	50.6
Total	**127,623**	**321.9**

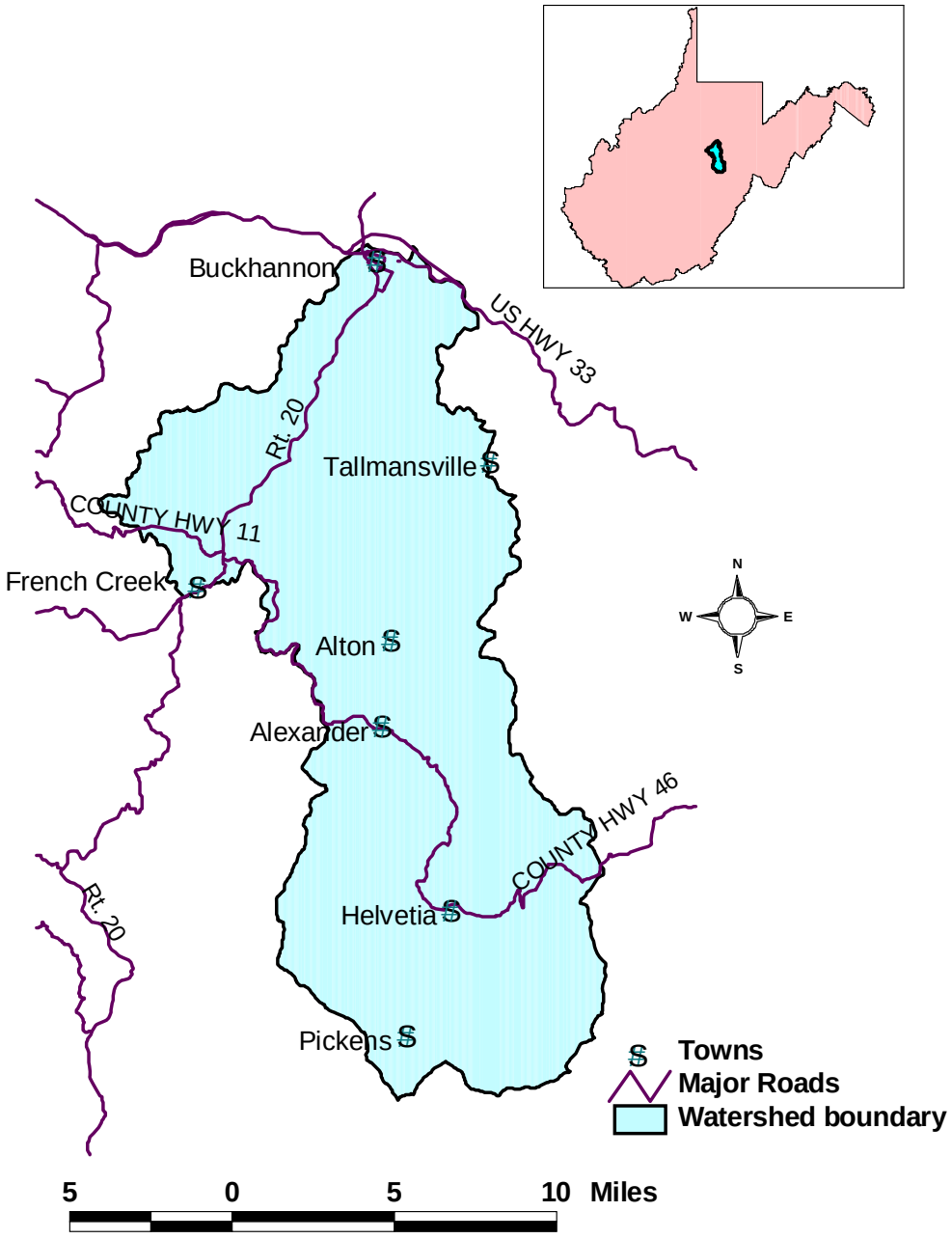

Figure 1. Map of the Upper Buckhannon watershed showing major roads and towns. The inset shows the watershed's location within West Virginia.

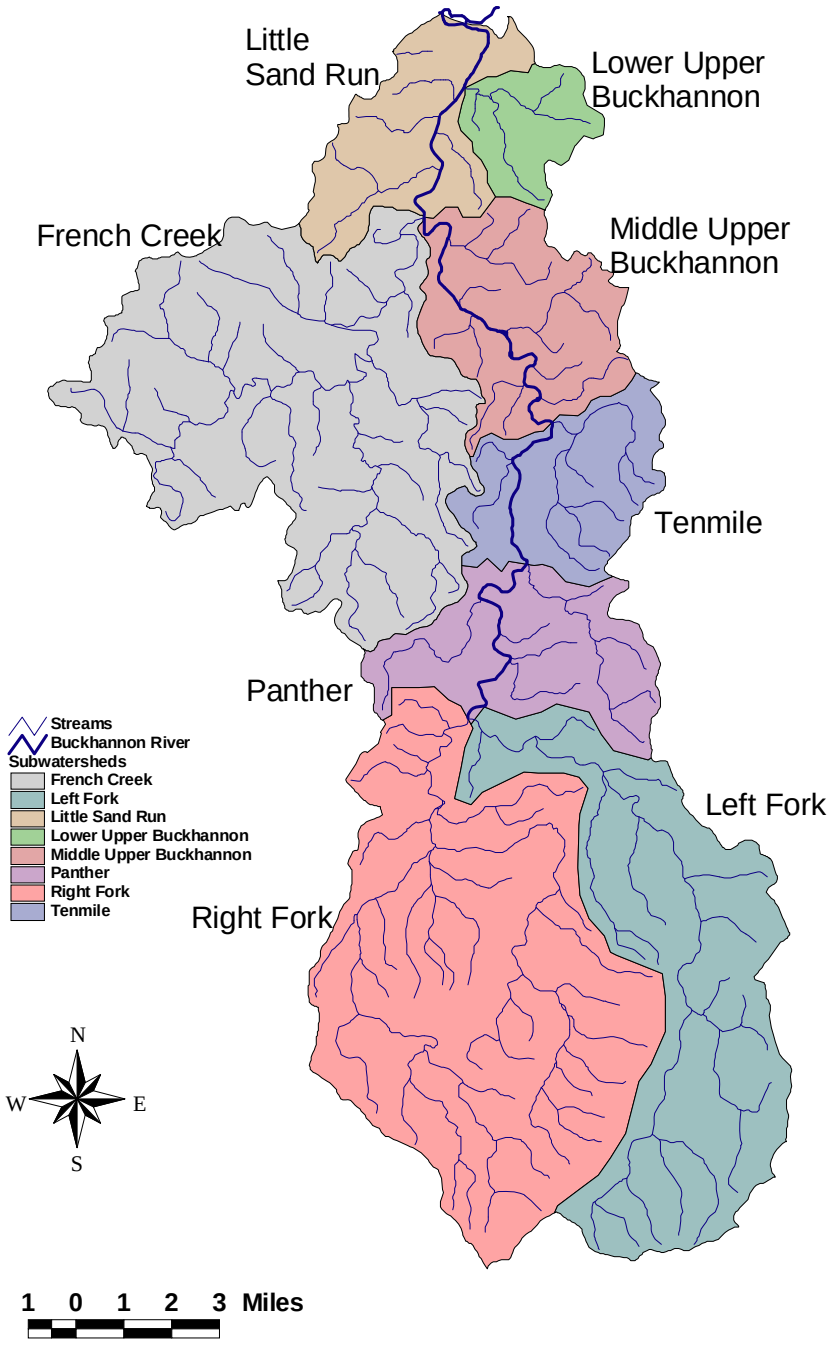

Figure 2. Map of the eight subwatersheds of the Upper Buckhannon watershed.

A.2. Measurable Water Quality Goals for the Upper Buckhannon

Metals: Achieve load reductions in iron, manganese, and aluminum as recommended in the 1998 TMDL report for the Buckhannon River and achieve 100% compliance with state water quality criteria in all streams in the watershed through load reductions and mitigation strategies. In B-1 and B-2 waters the iron criteria are 1.5 and 0.5 mg L^{-1}, respectively. For aluminum the criterion is 0.75 mg L^{-1}. The human health criterion for manganese is 1.0 mg L^{-1}.

pH/Acidity: Reduce loads and/or mitigate surface water to achieve 100% compliance with state water quality criteria in all streams in the watershed.

Sediment: There are no state water quality criteria for sediment and there is little information available on sediment loads in the watershed so a water quality goal cannot be established. However, sediment sources can be quantified. Our goal is for 100% of stream miles in the watershed to achieve a Habitat Score of 180 or greater using the Rapid Habitat Assessment Index.

Fecal Bacteria: Reduce loads and/or mitigate surface water to achieve 100% compliance with state water quality criteria for fecal coliform in all streams in the watershed. The state water quality standard for fecal coliform for recreational waters is no more than 200 CFU per 100 mL as a monthly geometric mean based on not less than 5 samples per month nor more than 400 CFU per 100 mL in more than ten percent of all samples taken during the month.

Biological Integrity: Most of the pollutants listed above have a negative impact on the biota of streams. To ensure that the biological integrity of streams is being preserved and maintained, biological assessments of streams should be conducted. These biological assessments of fish and benthic macroinvertebrate diversity and abundance answer the ultimate question, "Is overall water quality good enough to support a viable stream community?" Furthermore, bioassessments complement point-in-time chemical sampling because they are time-integrated measures of water quality. The goal here is a rating of 68% or better on the WV Stream Condition Index (WVSCI) for all streams in the watershed.

A.3. Causes and Sources of Pollution

In this section of the report we attempt to quantify the sources of contaminants. This is a challenging undertaking because the information is spread among diverse government agencies and private organizations. Nonetheless we are confident we have gathered together all of the most recent and most relevant data that exist for this watershed.

A.3.a. Metals

The main source of metals in the watershed is acid mine drainage (AMD) from abandoned mines (raw AMD) and perhaps some from active, permitted mines. A TMDL report was written in 1998 by EPA for the Upper Buckhannon watershed. The existing loads of aluminum, iron, and manganese from tributaries were such that the mainstem of the river from Alexander to Hampton violated state water quality standards for these three metals. The TMDL established target loads for each metal which, if achieved, should maintain the metal concentrations at acceptable levels.

Table 2. Estimated loads of aluminum, iron, and manganese in the Upper Buckhannon Watershed from the TMDL report (WV DEP 1998a). Figures for Tenmile Creek are from the draft TMDL for that watershed (WV DEP 1998b). Reductions are the amount by which the metal loading must be reduced so that the mainstem river does not violate water quality standards.

Subwatershed	Existing	Target	Reduction Needed	Percent Reduction Needed
	(lbs/yr)	*(lbs/yr)*	*(lbs/yr)*	*(%)*
Aluminum				
Left Fork BR	*17,901*	*14,101*	*3,800*	*21.2*
Beech Run of Left Fork	*12,941*	*6,037*	*6,904*	*53.3*
Upper Left Fork BR	*12,336*	*9,233*	*3,103*	*25.2*
Left Fork Total	43,178	29,371	13,807	32.0
Tenmile Creek	1,833	1,615	218	11.9
Other Sources	438,035	414,515	23,539	5.4
Total	**483,064**	**445,501**	**37,564**	**7.8**
Iron				
Left Fork BR	*23,312*	*18,044*	*5,269*	*22.6*
Beech Run of Left Fork	*17,974*	*8,020*	*9,954*	*55.4*
Upper Left Fork BR	*15,291*	*11,365*	*3,926*	*25.7*
Left Fork Total	56,577	37,429	19,149	33.8
Tenmile Creek	2,915	2,503	412	14.1
Other Sources	564,195	535,560	28,633	5.1
Total	**623,687**	**575,492**	**48,194**	**7.7**
Manganese				
Left Fork BR	*4,827*	*4,287*	*540*	*11.2*
Beech Run of Left Fork	*2,632*	*1,541*	*1,091*	*41.5*
Upper Left Fork BR	*2,506*	*2,173*	*333*	*13.3*
Left Fork Total	9,965	8,001	1,964	19.7
Tenmile Creek	nd	nd	nd	
Other Sources	142,874	140,873	2,259	1.6
Total	**152,839**	**148,616**	**4,223**	**2.8**

The existing loads, target loads, and the reductions needed are listed in Table 2. It is interesting to note that the majority of the metal loadings come from “other sources”, some of which are permitted point sources and others are non-point sources.

Chemical sampling by the Stream Restoration Group and West Virginia Wesleyan College has documented several other streams that appear to violate water quality standards for metals, although the number of samples taken in most cases is small (see Table 3). Twenty streams had high metal concentrations that were indicative of AMD contamination. These streams were distributed throughout all eight subwatersheds.

Table 3. Measured water quality parameters for select streams in the Upper Buckhannon Watershed divided by subwatershed. Samples were collected by West Virginia Wesleyan College's Environmental Laboratory or the WV Stream Restoration Group between 1997 and 2002. Only those samples with pH less than 5.75 or with Fe and Al concentrations greater than 0.5 and 0.75, respectively, are presented. This list represents the potential sources of pollutant loads in the Upper Buckhannon watershed. Asterisks denote streams that are listed on the state's 303(d) list.

Site Description	Sub-watershed	Collected Yr.	Mon	Day	Field Cond *(uS/cm)*	Field pH	Total Acidity *(mg/l carb)*	Total Fe *(mg/l)*	Total Mn *(mg/l)*	Total Al *(mg/L)*	Flow *(ft^3/s)*
Left Fork Subwatershed											
Left Fork Buckhannon River at Palace Valley	Left Fork	2002	5	2	41	6.75	1.0	**1.22**	0.108	**1.47**	--
Right Fork Subwatershed											
Right Fork Buckhannon River at Selbyville	Right Fork	2002	5	2	29	6.38	1.9	**1.4**	0	**1.61**	--
Panther Subwatershed											
Swamp Run near headwaters	Panther	2002	4	30	222	**3.62**	41.1	**0.965**	2.44	**4.75**	0.029
Unnamed Tributary 18 of Buckhannon River near mouth (from DLM)	Panther	2002	5	1	677	6.21	7.24	0.239	3.03	**1.49**	0.995
Unnamed Tributary 22 of Buckhannon River near mouth (from Alton)	Panther	2002	4	30	248	6.26	1.88	0.285	1.09	**0.804**	1.805
Tenmile Subwatershed											
Tenmile Cr. Bridge	Tenmile	1997	7	29	690	**4.88**	94.0	**0.76**	1.698	--	--
Tenmile Cr. Bridge	Tenmile	2001	10	9	1434	6.58	3.76	**2.06**	1.32	0.243	1.348
Tenmile Creek Left Fork near mouth	Tenmile	2002	4	30	1054	7.70	3.58	**0.678**	0.923	**1.19**	13.00

Table 3. (continued)

Site Description	Sub-watershed	Collected Yr.	Mon	Day	Cond (uS/cm)	pH	Total Acidity (mg/l carb)	Total Fe (mg/l)	Total Mn (mg/l)	Total Al (mg/l)	Flow (ft^3/s)
Middle Upper Buckhannon Subwatershed											
Unnamed Tributary 9 of Buckhannon River at mouth (above Sago)	MUB	2002	4	29	89	6.20	2.32	**1.06**	0	0.235	2.754
Cutright Run near headwaters*	MUB	2002	4	29	40	6.81	2.14	**0.889**	0.135	**1.38**	6.442
Cutright Run of Buckhannon River downstream of Lick Run (at highway) *	MUB	1998	11	2	168	7.67	472	**1.33**	--	--	--
Lick Run of Cutright Run	MUB	2002	4	29	64	6.76	2.48	**2.14**	0.117	**2.69**	8.462
Stony Run of Buckhannon River at mouth	MUB	2002	4	29	92	6.74	2.96	**1.15**	0	**1.61**	8.007
French Creek Subwatershed											
Bull Run near mouth	French Creek	2001	10	13	1144	7.30	470	**1.80**	0.4	**2.3**	--
Little Sand Run Subwatershed											
Left Fork Little Sand Run near headwaters	Little Sand	2002	4	29	55	6.70	2.0	**0.664**	0.215	**1.16**	2.4
Unnamed Tributary 5 of Buckhannon River at mouth (below Hickory Flat)	Little Sand	2002	4	29	132	6.83	3.16	**0.993**	0.129	**0.841**	2.46
Lower Upper Buckhannon Subwatershed											
Unnamed Tributary 2 of Buckhannon River at mouth (Vicksburg Run)	LUB	2002	4	29	168	7.30	3.66	**0.891**	0	**0.912**	1.8
Jawbone Run of Buckhannon River beside Bicentenniel Motel	LUB	2002	4	29	137	7.09	4.14	**0.645**	0	**0.962**	2.4
Ratcliff Run of Buckhannon River at mouth	LUB	2002	4	29	57	6.25	2.82	**0.936**	0	**1.15**	--
Unnamed Tributary 4 of Buckhannon River at mouth (below LSR)	LUB	2002	4	29	166	7.20	3.56	**0.74**	0	0.474	--

Focus on Panther Subwatershed

The Panther subwatershed contains several reclaimed surface mines, some of which have permitted discharges (bond forfeiture sites) and some of which are abandoned (Figure 3). Current active treatment methods have removed a majority of metals from the AMD draining from these sites; however, there are a few stream reaches that still violate water quality criteria.

Table 4 lists water chemistry data provided by the Special Reclamation Office of the WV DEP. These data show, except for the headwaters of Herods Run, that the streams are quite acidic. Furthermore, at some sites the average iron concentration exceeds the B-2 iron criterion of 0.50 mg L^{-1} and the maximum iron concentrations at all sites exceed both the B-1 and B-2 iron criteria. The sources of the acidity and iron are not completely clear. Undoubtedly a portion is contributed by permitted discharges but this detailed analysis of the Panther subwatershed indicates that additional treatment of AMD is required.

Table 4. Stream pH, total iron, and total aluminum at several locations along Swamp Run, two sites along Herod's Run, and one site along Smooth Rock Lick in the Panther Subwatershed. Samples were collected monthly from 1999-2002 except for Smooth Rock Lick which was sampled once in 2004. Aluminum was analyzed only once in Swamp Run. Bd = below detection.

	Swamp Run Sites				**Herods Run Sites**		**Smooth Rock Lick**
	23	**82**	**80**	**81**	**8**	**24**	**91**
pH							
Ave.	4.93	4.41	3.15	4.64	7.13	4.61	4.01
Min.	3.80	4.20	2.90	3.40	5.20	3.80	--
Max.	6.80	4.60	4.50	6.60	8.20	7.30	--
Total Iron (mg L^{-1})							
Ave.	0.40	0.20	6.93	0.64	0.73	0.27	0.40
Min.	0.08	bd	2.31	0.07	0.16	bd	--
Max.	1.82	3.03	10.90	3.22	2.43	3.12	--
Total Aluminum (mg L^{-1})							
Ave.	3.14	--	--	--	0.89	--	0.53
Min.	--	--	--	--	0.15	--	--
Max.	--	--	--	--	2.34	--	--

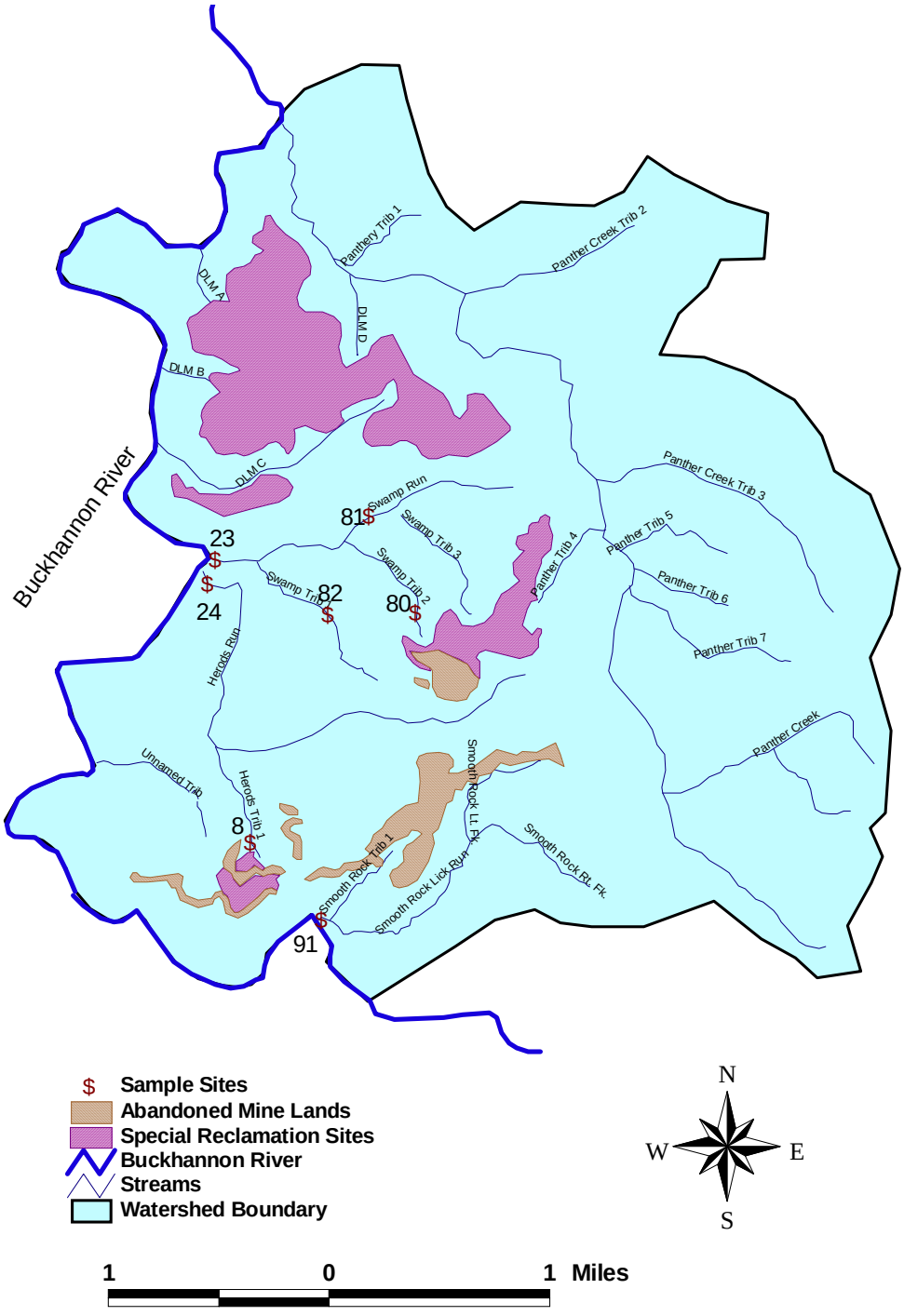

Figure 3. Detailed map of Panther subwatershed showing abandoned mine lands and special reclamation sites (bond forfeitures). The sample site numbers correspond to those in Table 4.

Focus on Tenmile Subwatershed

Tenmile subwatershed is 5,132 acres in size and contains 16.8 miles of streams. Tenmile Creek splits into the Right and Left Forks about one mile above the creek mouth (Figure 4). A large portion of the watershed is covered by the inactive Island Creek mine and processing plant. Several treatment ponds and two limestone dosers are used to treat the AMD before it is discharged. The Left Fork of Tenmile, however, still violates water quality standards on a regular basis (Table 3) and is typically orange in color. In April 2004 a macroinvertebrate collection by The Highlands Institute in the Left Fork resulted in a single organism (a midge larva), indicating that habitat quality is extremely poor.

With the help of an Office of Surface Mining college intern attached to the Buckhannon River Watershed Association, The Highlands Institute conducted a detailed survey of Tenmile watershed in June 2004. Two acid seeps were identified in the Left Fork of Tenmile watershed that were not being treated (Figure 4). The seeps contribute approximately 693 lbs. of iron and 170 lbs. of aluminum to the Left Fork of Tenmile creek annually. This corresponds to 24% and 9.8% of the Tenmile Creek loads, respectively, and very close to the targeted reductions recommended for Tenmile Creek by the TMDL report (see Table 3).

Table 5. Metal loads contributed to the Left Fork of Tenmile Creek by two AMD seeps compared to the total load at the mouth of Tenmile Creek. See Figure 5 for location of seeps.

Source	**Iron Load** *(lbs yr^{-1})*	**Aluminum Load** *(lbs yr^{-1})*
Seep A	529	9
Seep B	164	170
Seep Total	**693**	**179**
Tenmile Creek Total	2,915	1,833

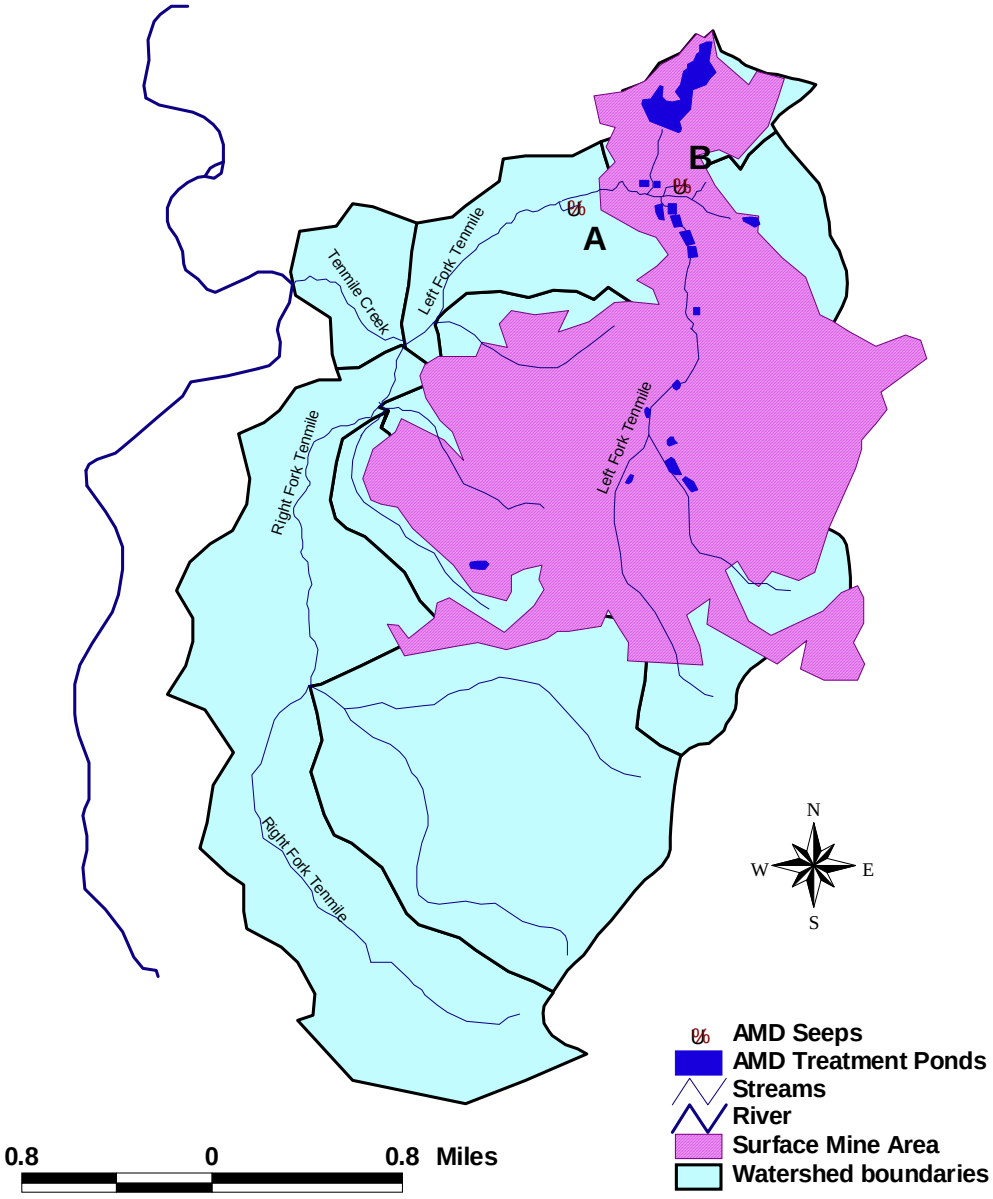

Figure 4. Detailed map of Tenmile subwatershed showing streams, surface mine coverage, acid mine drainage (AMD) treatment ponds, and AMD seeps.

Forty-four Abandoned Mine Lands (AML) Problem Areas are recorded within the Upper Buckhannon River Watershed. Two of these sites have been reclaimed. Of the 44 AML Problem Areas within the watershed, 7 are in the Lower, 3 are in the Middle, 14 are in French Creek, 5 are in the Right Fork, and 15 are in the Left Fork. The metal loads emanating from these sites are not known. (Figure 5). In addition, there are 34 permitted mines in the watershed with a combined total acreage of 3,443 acres (Table 6). They are distributed throughout all the subwatersheds except for Little Sand Run (Figure 5). Finally, there are 24 bond forfeiture sites located within French Creek (1), Panther (12), Left Fork (7), and Right Fork (4) subwatersheds (Figure 5).

Table 6. Tally of the status of permitted mines within the Upper Buckhannon watershed.

Number of Permits	Status
8	Active
2	Completely Released
20	Inactive
2	New
1	Phase 1 Released
21	Renewed
1	Revoked
8	Unknown

In summary, high metal concentrations have been found in all eight of the subwatersheds within the Upper Buckhannon. In many cases the source of metal contamination is unknown. Tenmile and Panther subwatersheds seem to be two of the largest sources and are therefore of a high priority. Further sampling and monitoring will be needed to pinpoint the sources of these pollutants.

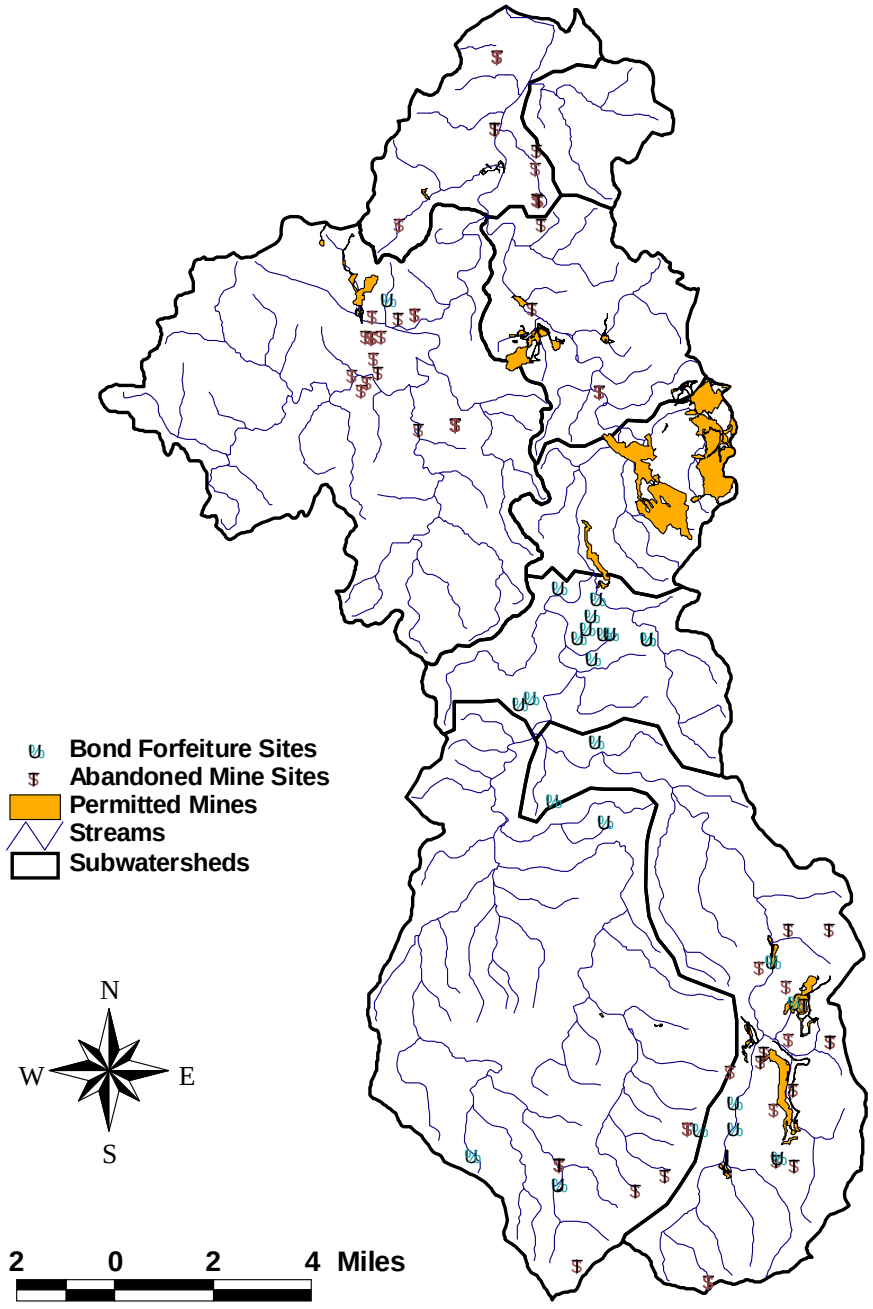

Figure 5. Map of Upper Buckhannon watershed showing bond forfeiture sites, abandoned mine sites (AML), and permitted mine sites.

A.3.b. pH/Acidity

WV DEP listed six streams from the Upper Buckhannon watershed on its 2002 303(d) List of Impaired Streams (Table 7). The cause of impairment in all cases was pH which could have been caused by AMD, acid precipitation or both. For example, the Right Fork of Tenmile subwatershed contains AML problem areas and 3 bond forfeiture sites, so some of the pH violations are probably due to AMD. In contrast, there is no mining in the Bear Camp Run watershed; therefore, the most likely cause is acid precipitation. Not included on this 303(d) list were those streams that were impaired by metals and which are included in the TMDL process.

Table 7. The list of impaired streams from the 2002 303(d) list in West Virginia. Only streams in the Upper Buckhannon Watershed are shown.

Stream Name	Stream Code	Criteria Affected	Impaired Length (mi)	Reach Description
BEAR CAMP RN	WVMTB-32-D	pH	5.5	(Entire length)
BEECH RUN/LT FK/BUCKHANNON R	WVMTB-32-H	pH	5.2	(Entire length)
CUTRIGHT RN	WVMTB-17	pH	4.2	(Entire length)
MARSH FK	WVMTB-31-J	pH	5.5	(Entire length)
RT FK TENMILE CK	WVMTB-25-A	pH	4.0	(Entire length)
SMOOTH ROCKLICK RUN	WVMTB-32-A	pH	2.0	(Entire length)
TOTAL MILES			**28.6**	

In addition to the 24 bond forfeiture sites, the 63 permitted mines, and the 44 AML sites, central WV receives some of the most acidic precipitation in the nation with a mean annual rain pH of about 4.6 (National Atmospheric Deposition Program, http://nadp.sws.uiuc.edu). This equates to about 0.45 lbs H^+ ion per acre each year (as measured at the closest NADP monitoring site located in Parsons, WV). Much of this acidity is absorbed or neutralized by vegetation and soils before it enters streams.

Streams that are impaired by acid precipitation are characterized by low pH, low conductivity, low alkalinity and low metal concentrations. In contrast, AMD-impacted streams exhibit either low or high pH, high conductivity, sometimes high alkalinity, and elevated metal concentrations. Streams that appear to be impaired by acid precipitation were designated as such based on water chemistry data collected between 1997 and 2002 by the Stream Restoration Group (WV DEP) and WV Wesleyan College. These streams are presented in Table 7 below.

Acid precipitation appears to be affecting 16 stream reaches. This list is similar to the 303(d) list, which reported 28.6 miles of pH-impaired streams, but there are a few discrepancies. All of the acid precipitation-impacted streams are located in just four subwatersheds, namely Left Fork, Right Fork, Panther, and Tenmile (Figure 6). The miles of impaired stream in Table 7 adds up to 29.7 miles.

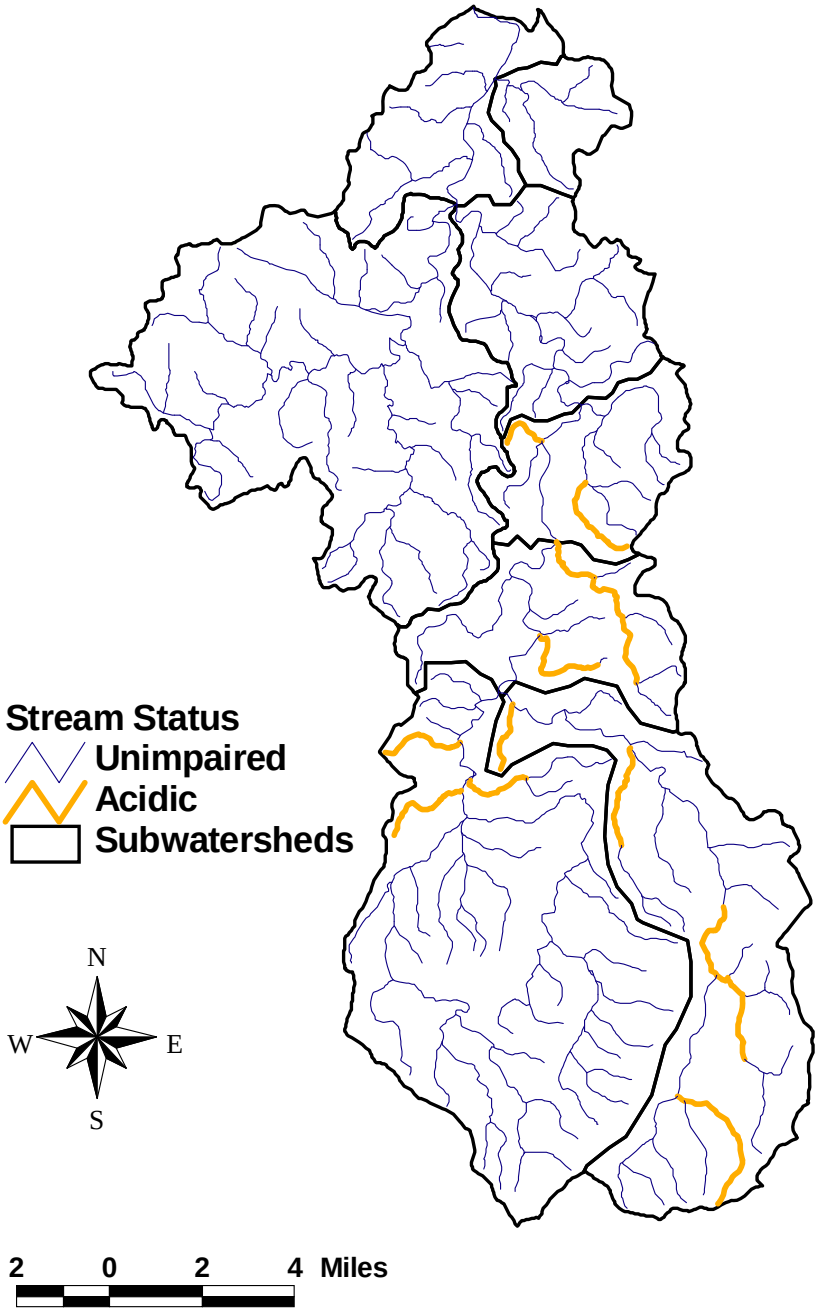

Figure 6. Map of streams impaired by acid precipitation in the Upper Buckhannon watershed.

Table 7. Measured water quality parameters for select streams in the Upper Buckhannon Watershed divided by subwatershed. Samples were collected by West Virginia Wesleyan College's Environmental Laboratory or the WV Stream Restoration Group between 1997 and 2002. Only those samples with pH less than 5.75. This list represents the potential sources of acid loads in the Upper Buckhannon watershed. Asterisks denote streams that are listed on the state's 2002 303(d) list.

Site Description	shed	Collected Yr.	Mon	Day	Field Cond. *(uS/cm)*	Field pH	Total Acidity *(mg/l carb)*	Total Fe *(mg/l)*	Total Mn *(mg/l)*	Total Al *(mg/L)*	Stream Miles *(mi)*
Left Fork Subwatershed											
Beech Run of Left Fork Buckhannon River upstream of Bear Run *	Beech	2002	5	1	18	**4.65**	3	0	0	0.191	2.2
Bear Camp Run of Left Fork Buckhannon River at mouth *	LLF	1997	7	29	20	**4.60**	57	0	0.039		2.3
BR at Star Bridge	LLF	1997	5	29	20	**5.75**	27	0.08	0		1.8
Unnamed Tributary 1 of Left Fork Buckhannon River at mouth	LLF	2002	4	30	19	**5.68**	1	0	0	0.144	1.6
Unnamed Tributary 11 of Left Fork Buckhannon River at mouth	LLF	2002	5	1	16	**5.55**	2	0	0	0	0.3
Unnamed Tributary 12 of Left Fork Buckhannon River at mouth	LLF	2002	5	1	12	**5.66**	2	0	0	0	0.2
Phillips Camp Run of Left Fork Buckhannon River near mouth	ULF	2002	5	1	18	**5.08**	2	0.136	0.29	0.207	3.3
Right Fork Subwatershed											
Alec Run of Right Fork Buckhannon River at mouth	LRF	2002	4	30	20	**4.79**	1.16	0	0.187	0.243	1.9
Bens Run of Right Fork Buckhannon River at mouth	LRF	2002	5	2	16	**5.59**	6	0.173	0	0.262	2.1
Millsite Run of Right Fork Buckhannon River near headwaters	LRF	2002	5	2	25	**5.69**	2.42	0.264	0	0.153	1.5
Unnamed Tributary 10 of Right Fork Buckhannon River at mouth	LRF	2002	5	1	18	**5.19**	4	0	0	0.126	0.2
Panther Subwatershed											
Herods Run of Buckhannon River at mouth	Panther	2002	4	30	55	**4.56**	7.78	0	0.332	**0.784**	2.3
Panther Creek at Stockert site near headwaters	Panther	2002	5	1	16	**4.94**	4.66	0	0	0	1.6
Panther Creek of Buckhannon River at mouth	Panther	2002	5	1	37	**5.07**	1.64	0	0	0.305	2.7

Table 7. (continued)

Site Description	shed	Yr.	Mon	Day	Field Cond. *(uS/cm)*	Field pH	Total Acidity *(mg/l carb)*	Total Fe *(mg/l)*	Total Mn *(mg/l)*	Total Al *(mg/l)*	Flow *(cfs)*
Tenmile Subwatershed											
Right Fork Tenmile Creek near headwaters*	Tenmile	2002	4	30	25	**4.05**	2.5	0	0	0.162	4.5
Unnamed Tributary 14 of Buckhannon River near mouth (above Tenmile)	Tenmile	2002	5	1	15	**5.22**	1.58	0	0	0	1.2
Total Miles											**29.7**

A.3.c. Sediment

Sediment from Agriculture

The Upper Buckhannon River watershed consists of approximately 127,600 acres. About one-fifth, approximately 26,686 acres (Table 1), is being used for agriculture. Most of the 112 farms present in this watershed are involved in hay and beef production with an average of 35 head of cattle per herd. One-sixth of the farms located within the watershed have management plans (NRCS and WV Conservation Agency, personal communication). Visual inspection of several farms shows the potential for erosion and sediment influx to streams due to lack of riparian buffer zones and lack of streamside fences.

Sediment from Forestry

The Upper Buckhannon River watershed is about 75% forested and most of the forested land is privately owned. Both deciduous and mixed forests are common in this watershed. In 2003, there were 49 logging operations registered with the WV Division of Forestry (Jim Hayes, personal communication) that covered a total of 3,748 acres. This includes 5 operations in which a total of 124 acres were clearcut. The WV DOF estimates that about 8% of the logged area, or 300 acres, was disturbed (i.e., converted to roads and landings). All registered logging operations are required to use best management practices (BMPs) and are periodically inspected by the DOF.

Sediment from Oil and Gas Roads

There are approximately 1,337 oil and gas wells within the Upper Buckhannon River watershed (WRAS, 1999). The status of these wells is described in Table 8 and their locations are plotted in Figure 7. The Division of Oil and Gas estimates that 205 miles of oil and gas roads exist in the watershed and that 128 miles of these are critically eroding. Furthermore soil along 90% of gas pipelines is critically eroding. Thus, there is tremendous erosion potential from these widespread sources.

Table 8. Status of oil and gas wells within the Upper Buckhannon River watershed according to WV DEP GIS shape files (2004).

STATUS	# OF WELLS
Unknown	119
Abandoned	59
Active	809
Future Use	39
Never Drilled	74
Plugged	237
Total	**1,337**

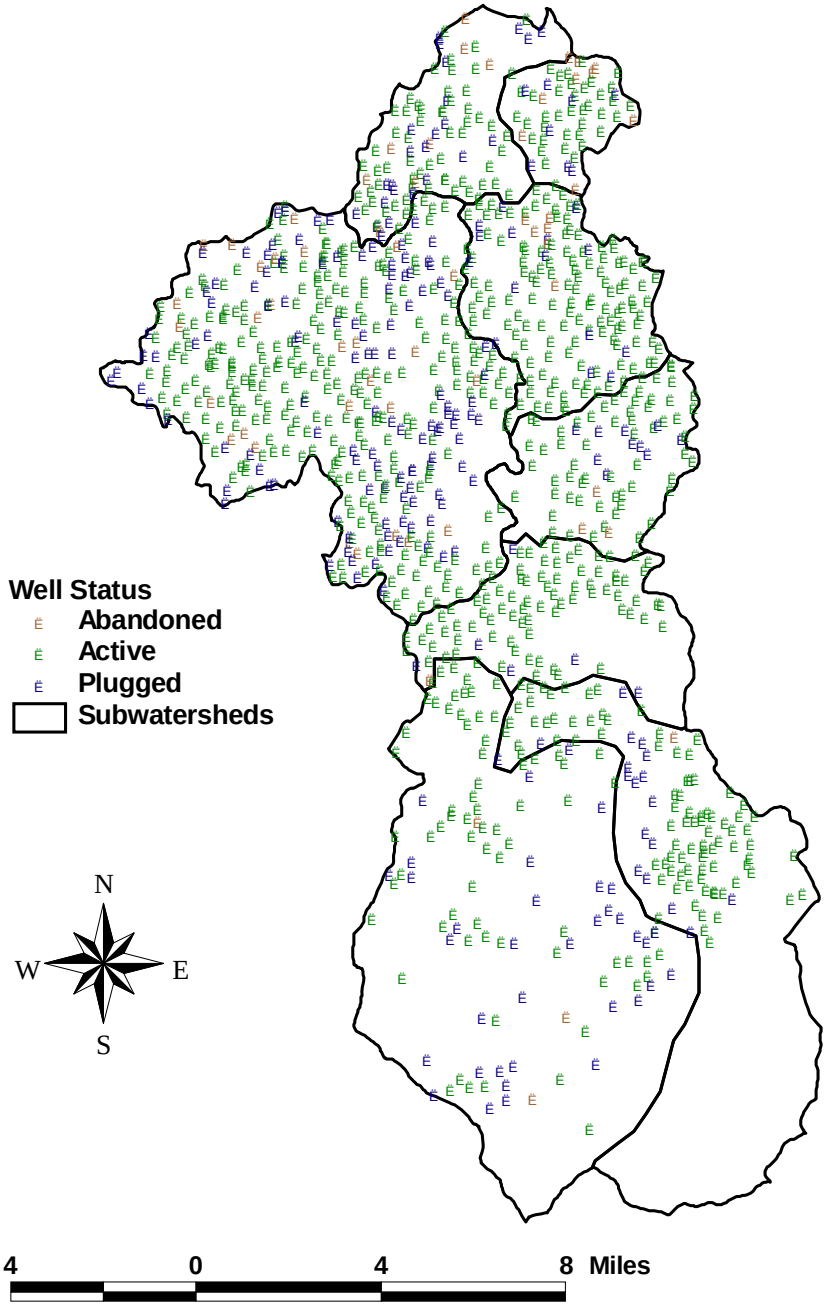

Figure 7. Map of gas well locations in the Upper Buckhannon River Watershed according to WV DEP GIS shape files (WV DEP 2004).

A.3.d. Habitat Quality

In 1997 WVDEP conducted an ecological assessment of the Tygart Valley River Watershed, which includes the Buckhannon River Watershed. One of the parameters they examined was habitat quality in the stream channel and riparian zone. The Rapid Habitat Assessment (RHA) Score is a combination of scores that measure: in-stream cover, substrate size, embeddedness, velocity/depth regime, channel alteration, sediment deposition, riffle frequency, channel flow status, bank condition, bank vegetative protection, grazing, and riparian vegetation zone width. Twenty-six stream sections were assessed. The average score was 166 (on a scale of 12 to 240), which is considered sub-optimal. The highest score was 195 (optimal) and the lowest was 123 (sub-optimal). All six streams fell in the sub-optimal range (120 to 180). Thus, stream habitat overall is not adequate to sustain healthy biological communities (Table 9).

Table 9. List of streams with WVSCI scores < 61 (impaired) or with Habitat Scores less than 120 (poor to marginal). Source: WVDEP (2003).

Stream Name	Subwatershed	WVSCI	RHA Score
Mudlick Run	French Creek	**41.8**	123
Bull Run	French Creek	**56.4**	143
Sawmill Run	Middle U.B.	**52.3**	162
Laurel Run	French Creek	**56.3**	154
Tenmile Creek	Tenmile	**49.5**	147
Panther Fork	Panther	**59.5**	137
Average		**69.0**	166

During that same 1997 assessment the WVDEP evaluated biological integrity of using the WV Stream Condition Index (SCI) based on benthic macroinvertebrate counts. The SCI is a combination of six different metrics that assess the diversity and abundance of macroinvertebrate populations. The scale ranges from 0 to 100 with categories of Impaired (0 to 61), Gray Zone (61 to 68), and Good (68 to 100). Twenty-three stream sections were assessed and they had an average score of 69.0 (on a scale of 0 to 100), which is just above the "gray zone" in the Good category. The highest score was 82.3 (Good) and the lowest was 41.8 (Impaired). The six impaired streams (with scores below 61) are listed in Table 9.

In summary, although the habitat in the six streams studied was not poor or marginal, the biological diversity was impaired which suggests chemical factors (like acidity or AMD) are mainly responsible for the low diversity.

A.3.e. Fecal Bacteria

Fecal coliform contamination has been a concern in the Buckhannon River watershed for several years. In 1998 a student and professor at West Virginia Wesleyan College conducted a watershed-wide survey of over 30 locations along the mainstem of the river and many of its tributaries (Long and Simmons, 1998). The most severely contaminated tributaries were located in and around the city of Buckhannon (Middle Upper Buckhannon, Tenmile, and Little Sand Run subwatersheds). These included Hickory Flats Run, Tenmile Creek, Stony Run, Ratcliffe Run,

Little Sand Run, Cutright Run, and the Buckhannon River mainstem from Sago to the public water intake.

Since 2001 the Buckhannon Sewer Department has been monitoring fecal coliform levels in the river mainstem in and around Buckhannon and has found that higher flows lead to dramatic increases in coliform concentrations which often exceed 1,000 CFU per 100 mL (Simmons, 2003). In 2002 the Stream Restoration Group from the WV DEP sampled a large number of sites for coliform. Table 10 shows the results of three separate sampling series conducted between 1998 and 2004. A total of 39.1 miles of stream showed violations of the state criteria for fecal coliform on at least one of the sampling dates. The majority of these streams were in the Lower and Little Sand Run subwatersheds (Figure 8).

In 2003 the BRWA was awarded a Stream Partners Grant to pursue additional coliform testing. The main goal of this sampling was to perform an intensive sampling of a few tributaries to determine whether or not the streams should be categorized as "Impaired" according to state water quality criteria. The geometric mean of coliform concentrations from this sampling series is shown in Table 10. West Virginia's water quality regulations state that if the mean coliform concentration (the geometric mean of no less than 5 samples taken during a one-month period) is greater than 200 CFU per 100 mL, then the water body should be considered "Impaired" for recreation and drinking water uses. All six sampling sites would be considered impaired according to state water quality criteria during April 2004.

The source of the bacterial contamination is currently under investigation. The BRWA in cooperation with The Highlands Institute is developing a bacterial source tracking method (using antibiotic resistance) to help determine if the bacteria are coming from cattle, humans, wildlife, or other sources.

Table 10. Fecal coliform concentrations (CFU per 100 mL) in the Upper Buckhannon watershed on three different sampling dates. The 1998-99 values represent either single samples or the means of 2 to 4 samples. The May 2002 values are single samples. In the April 2004 column the values represent the mean of five collections within that month. Blanks indicate that no sample was collected on that date.

			Date Sampled		
Description	**Subshed**	**Stream Miles**	**1998-99**	**May 2002**	**April 2004**
Ratcliffe Run at mouth	LUB	1.8	4,864	440	1,036
Hickory Flats Run at mouth	LUB	2.1	28,000	1,700	628
Buckhannon River at Water Intake	LUB	3.3	677		220
Little Sand Run at mouth	Little Sand	1.0	4,102	636	811
Little Sand Run upstream of Left Fork Little Sand Run	Little Sand	3.5		400	
Left Fork Little Sand Run at mouth	Little Sand	3.6		360	1,049
Lick Run of Cutright Run	MUB	1.6		3,400	
Stony Run	MUB	2.1	1,840		
Cutright Run downstream (at highway)	MUB	1.7	850	3,000	422
Cutright Run near headwaters	MUB	1.7		545	
Laurel Run near mouth	MUB	2.4	370	330	
Grassy Run near mouth	MUB	1.0		310	
Grassy Run near headwaters	MUB	1.1	420	4,700	
Sharps Run of Little Laurel Run	MUB	1.0		250	
Buckhannon River at Hampton	MUB	2.6		210	
BR at Sago	MUB	0.9	842		
French Creek near mouth	French Ck.	2.0	1,077	1,455	
BR at Alton	Panther	1.0	176		
Tenmile at Mouth	Tenmile	1.1	2,850		
Alec Run at mouth	Right Fork	1.0		1,000	
Right Fork BR at Selbyville	Right Fork	0.6		400	
Right Fork BR at Silica	Right Fork	2.0		360	
Total Miles		**39.1**			

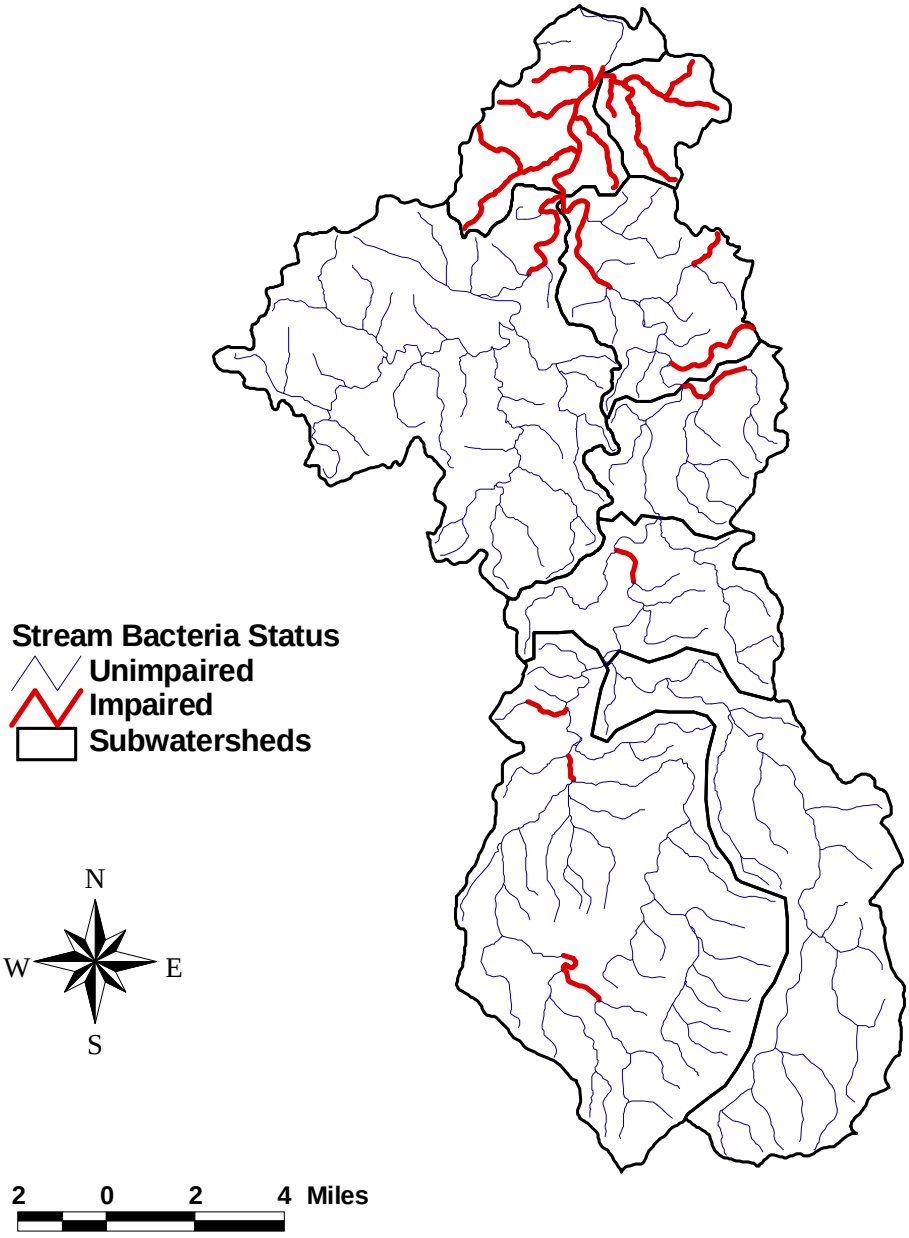

Figure 8. Map of bacteria-impaired streams in the Upper Buckhannon watershed.

B. Load Reductions Expected

B.1. Metals

Project 1: There is very little water chemistry data available to estimate metal load reductions. However, WV DEP collected monthly water chemistry data from the headwater of Tributary 1 of Herod's Run which drains a portion of the project area. The chemistry data were used to make rough estimates of total annual loads in this stream for iron, manganese, and aluminum which were 170, 216, and 156 lbs yr^{-1}, respectively. Thus, the maximum possible load reduction, assuming complete removal of all metals, is equal to these total annual loads (Table 11). The actual load reduction will likely be slightly less than these amounts because it is not practical to remove all metals from surface water.

Project 2: Total annual loads for Swamp Run and Herods Run were calculated from monthly chemistry and flow data collected by WV DEP at the mouth of these streams from 1999-2004. The annual loads from these two streams together for iron, manganese, and aluminum were 2,068, 9,015, and 9,411 lbs yr^{-1}, respectively (Table 11). Again these are maximum possible reductions assuming metal concentrations will be reduced to zero in the stream water.

Project 3: The Tenmile project will lead to reductions in metal concentrations. The annual loads from untreated AMD seeps in Tenmile Creek are listed in Table 5. If we assume that metal concentrations from these seeps will be reduced to zero, the load reduction equals the existing total annual load (Table 11).

Table 11. TMDL target reductions in metals compared to the maximum reductions possible from projects 1 – 3. Projected reductions in load were calculated from monthly samples at the mouths of Swamp Run and Herods Runs (Project 2) and the headwaters of Herods Run (Project 1) between 1999 and 2004. Data provided by M. Reese, WV DEP.

	Iron *(lbs yr^{-1})*	**Manganese** *(lbs yr^{-1})*	**Aluminum** *(lbs yr^{-1})*
Reduction Target	48,194	4,223	37,564
Project 1	170	216	156
Project 2	2,068	9,015	9,411
Project 3	693	no data	179
Total Reductions	**2,931**	**9,231**	**9,746**
Total as % of Target	**6.1%**	**218%**	**25.9%**

B.2. pH/Acidity

Projects 1-2: Acid neutralization is a part of the reclamation process in projects 1 and 2. Using monthly chemistry and discharge data collected by WV DEP at Swamp Run and Herods Run, total annual load of acidity was calculated. Assuming a 95% reduction in

acidity in these streams yields predicted reductions of 76,972 and 43,210 lbs yr^{-1} of CaCO3 equivalents, respectively. Thus, total acidity reduction will be 120,182 lbs yr^{-1} of CaCO3 equivalents.

Project 4: The WV Division of Natural Resources limestone application project will address acidity generated in the Right Fork and Left Fork of the Buckhannon River. Limestone will be added each year to six streams at a dose that is calculated to neutralize all of the acidity exported from each stream (i.e., to bring the pH to 7.0). Therefore, we expect a 95% acid load reduction for those streams ("Total acidity" is measured as acidity present below pH 8.3. Since pH in these streams will only be increased to 7.0, there will be a small amount of "total acidity" remaining). A very rough calculation of load reduction can be made from an estimate of total annual discharge (22.7 million cubic meters per year for the Right Fork and 15.0 million cubic meters per year for the Left Fork) and mean total acidity (2.1 mg L^{-1} for the Right Fork and 1.4 mg L^{-1} for the Left Fork; averages of 3 samples collected from 1996 to 2003). Assuming a 95% reduction in Total Acidity would lead to a reduction in annual acid load of 99,869 lbs yr^{-1} in the Right Fork and 43,871 lbs yr^{-1} in the Left Fork.

B.3. Sediment and Fecal Bacteria

Project 5: It is not possible to estimate reductions in sediment and fecal bacterial load in streams in the Upper Buckhannon watershed because of a dearth of sediment and bacterial measurements. However, we can estimate the number of stream miles that will be improved to the point where sediment and bacterial inputs will be minimal. Implementation of agriculture BMPs will restore approximately 24 miles of stream banks and riparian zones. According to Table 10 approximately 39 miles of stream are currently impaired by fecal coliform. So the proposed project could reduce coliform inputs by as much as 61%.

C. Nonpoint Source Management Measures

C.1. Project 1: AML PAD No. WV3173

The WV Office of Abandoned Mine Lands and Reclamation is responsible for reclaiming abandoned mine sites through proper disposal and burial of waste rock and slag which helps prevent AMD formation. They also install active and passive treatment systems to reduce acid loads in tributaries. AML&R maintains a prioritized list of abandoned sites that require remediation.

One high-priority site is located in the Panther subwatershed (PAD No. WV3173; Alton Highwalls; the brown areas in Figure 3). It is the site of an abandoned strip mine over a very acidic coal seam. AMD discharges from the area have not been documented but they are very likely to exist based on water chemistry data from streams below the site (Herods Run and Smooth Rock Lick Run). The proposed project would entail covering several sections of highwall and installing an AMD treatment system on-site or in-stream.

WV Division of Water and Wastewater will work with the WV Abandoned Mine Lands and Reclamation Office to design the project, obtain funding from the AML&R Office as well as EPA (Section 319), and then implement the project.

C.2. Project 2: Swamp Run and Herods Run

Both metals and pH are a problem in Swamp Run and Herods Run which are located within the Panther subwatershed. They drain several areas of a bond forfeiture site (purple areas in Figure 3). Before a reclamation plan can be designed a more detailed survey of these small watersheds needs to be conducted to identify all of the sources of AMD. It is possible that additional active treatment systems, like alkaline-amendment ponds or wetlands, will need to be installed

Where active treatment systems are not feasible, an alternate approach would be in-stream metal removal using limestone sand. Piles of finely-ground limestone would be placed in stream channels on an annual basis. During the year, the pile would gradually dissolve and erode adding alkalinity to the stream system. This technique has been used with great success by the WV DNR for several years to treat acid precipitation. It is likely to be successful in AMD streams as well. Limestone dosers are another commonly used in-stream system. A watershed cooperative agreement with the Office of Surface Mining is a likely source of funding.

C.3. Project 3: Stream Restoration in Tenmile Creek Subwatershed

Tenmile Creek subwatershed is dominated by a large inactive surface mining operation. The site discharges a large quantity of treated AMD and is in compliance with its permits, yet several stream reaches within the watershed violate state standards for pH, metals, and biological integrity (see Tables 3, 6, and 7). Furthermore, Tenmile Creek contributes over 4,700 lbs of iron and aluminum to the Buckhannon River each year. There are two acid seeps in the Left Fork of Tenmile watershed that are not being treated and that discharge significant quantities of AMD (Table 5).

The proposed project will treat the AMD being discharged from these seeps. Engineers from the National Mine Land Reclamation Center in Morgantown, WV will be asked to develop plans for a treatment system based on the quantity of AMD, its concentration, and the geology of the area. Funding for the project will be sought through the 319 program and through a Watershed Cooperative Agreement with the federal Office of Surface Mining. Pre- and post-monitoring will be an integral part of this project.

C.4. Project 4: Limestone Application to Streams

The WV Division of Natural Resources has proposed adding limestone sand to acid-impacted streams in the Upper Buckhannon River Watershed. Limestone will be added each year to about 12 streams at a dose that is calculated to neutralize all of the acidity exported from each stream (i.e., to bring the pH to 7.0). The sampling locations have not yet been finalized but will likely include Bear Camp Run, Phillips Camp Run, Beech Run, and the Left Fork itself (all within the Left Fork Subwatershed) as well as Marsh Fork, Alec Run, Bens Run, Millsite Run and sites along the Right Fork (within the Right Fork Subwatershed). The alkalinity added by this project will not only restore the pH of the targeted streams but will also improve the

buffering capacity of the river mainstem for several miles downstream. This project is already in the design stage and funding for the treatment has been secured by the WV Division of Natural Resources but additional funding will be required for monitoring.

C.5. Project 5: Implementation of Agriculture Best Management Practices

Sediment and fecal bacteria reduction within an agricultural operation can best be achieved by the implementation of Best Management Practices or BMPs. These BMPs are designed and established to help reduce the delivery of agricultural nonpoint source pollution to state waters. A second benefit to the implementation of BMPs is that they can make a farmer's agricultural operation run more efficiently saving time and money. A few BMPs that reduce sediment and bacterial inputs to streams include: rotational grazing, fencing, alternative water sources, stream crossings, buffer and filter strip, riparian area development, winter feeding areas, and roof run off management. These BMPs work to reduce water flow over bare ground, reduce the amount of bare ground, and encourage vegetative growth. WVCA estimates approximately 48 miles of streams and riparian zones in the Upper Buckhannon watershed will be improved by this project.

The WV Conservation Agency and the Natural Resources Conservation Service work with private landowners and farmers and encourage them to implement BMPs on their land through a series of incentive, education, and technical assistance programs. Two funding sources for these programs currently are EQUIP and CLEP programs. The WVCA and NRCS will also seek 319 funds to expand their ability to offer incentive programs and to offer a greater diversity of programs to landowners. WVCA estimates approximately 24 miles of streams and riparian zones in the Upper Buckhannon watershed will be improved by this project.

C.6. Project 6: Reclamation of Gas Pipeline

Through the use of Clean Water Act Section 319 Incremental Project funds 3,000 feet of eroded pipeline right-of-way will be restored. This will be achieved through reshaping, installing breakers, diversions, broad-based dips, out sloping and other Best Management Practices to control the velocity and discharge of water causing erosion and sediment deposition in streams**.**

Many pipelines and pipeline access points are used as dual purpose roads by the oil and gas industry as well as the logging industry. Unauthorized ATV use on these roads has also been a significant contributor to excess sediment entering the streams. A demonstration project will be implemented in an effort to find methods to resolve these issues.

C.7. Project 7: Coordination and Education

Because of the multi-agency cooperation needed for efficient non-point source reclamation efforts, this plan would not be complete without a strategic plan for coordination and education. The Buckhannon Framework Steering Committee (BFSC) is a multi-organizational body that includes representatives from state, federal, and county agencies, non-profit interest

groups, and business and is facilitated by Jennifer Pauer of the WV DEP. This makes it an ideal coordinating body for the watershed-based implementation plan.

A subcommittee of this group will be responsible for disseminating this plan to the BFSC, monitoring the progress of all non-point source projects, making annual reports to the BFSC, ensuring that monitoring is performed on schedule, gathering and storing monitoring data and other data, and revising the WIP as scheduled. The subcommittee will consist of at least four members of the BFSC including at least one Non-Point Source Specialist from the WV DEP and at least one representative of the Buckhannon River Watershed Association.

In order to evaluate the progress of implementation projects and to ensure that proper monitoring is conducted, a biennial Progress Report will be written by the subcommittee and submitted to the BFSC. The Highlands Institute for Environmental Research and Education has agreed to serve as the central repository for data.

The subcommittee will work with the Buckhannon River Watershed Association, The Highlands Institute for Research and Education, WV Conservation Agency, WV Division of Forestry, and WV Office of Oil and Gas to implement education and outreach objectives and to assess their effectiveness.

Monitoring for metals, sediment, and bacteria and periodic bioassessments require the coordination of several state agencies and other organizations (see section I). The subcommittee and the BFSC will be the coordinating bodies to avoid duplication of efforts and to ensure monitoring occurs on schedule. Benthic macroinvertebrate data, in particular, are lacking so collecting this information will be a high priority in the first few years.

Finally, in order to be able to calculate existing loads more accurately and to make predictions about load reductions, a simple hydrologic model of the watershed needs to be developed. Such a model will simulate water flow in the river mainstem as well as in major tributaries and be simple enough for the subcommittee to employ. There are several models available that could be adapted to the Upper Buckhannon. One is BASINS which is available from EPA. Another is being developed by Dr. Bruce Edinger at Salem International University in West Virginia.

All of the above activities will require a modest amount of resources that will be obtained through grant funding, in-kind matches (e.g., citizen volunteers), and state and federal operating expenses (i.e., employee time). There are many funding opportunities available for environmental education projects through the federal government (like EPA) and private foundations like SURDNA.

D. Financial and Technical Assistance Required for Implementation

D.1. Project 1: AML PAD No. WV3173

Backfilling the highwall
[65,205 ft2 @ $5/ft2] $ 326,025

Pre- and Post-Monitoring (2 years)
Comprehensive chemical sampling plus benthic macroinvertebrates will cost $1,200/site/yr.
[6 sites @ $1,200/site/yr * 2yrs] $ 14,400

AMD reclamation for 1.5 miles of Smooth Rock Lick Run and headwater region of Herods Run. WV DEP estimates an average of $300,000/mi for restoration of AMD-impacted streams.
[1.5 mi. @ $300,000/mi] $ 450,000

Project 1 Total: $ 790,425

Technical Assistance

WV Office of Abandoned Mine Lands and Reclamation
National Mine Lands Reclamation Center, WV University
Buckhannon River Watershed Association
WV Division of Water and Wastewater

D.2. Project 2: Swamp Run and Herods Run

AMD reclamation for 1.0 miles of Swamp Run and 1.2 miles of Herods Run. WV DEP estimates an average of $300,000/mi for restoration of AMD-impacted streams.
[2.2 mi. @ $300,000/mi] $ 660,000

Pre- and Post-Monitoring (2 years)
[10 sites @ $1,200/site/yr * 2yrs] $ 24,000

Project 2 Total: $ 684,000

Technical Assistance

WV Office of Abandoned Mine Lands and Reclamation
WV Division of Natural Resources
National Mine Lands Reclamation Center, WV University
WV Division of Water and Wastewater

D.3. Project 3: Stream Restoration in Tenmile Creek Subwatershed

Phase I – Surveying and Monitoring	
[4 sites @ $1,200/site/yr]	$ 4,800
Design of Treatment System	$ 5,000
Installation of Treatment System	
[0.2 mi. @ $300,000/mi]	$ 60,000
Post-operation Monitoring	
[4 sites @ $1,200/site/yr]	$ 4,800
Project 3 Total:	**$ 74,600**

Technical Assistance

WV Division of Water and Wastewater
WV Save Our Streams
National Mine Lands Reclamation Center, WV University
US Office of Surface Mining
The Highlands Institute, WVWC

D.4. Project 4: Limestone Application to Streams

Right Fork Buckhannon Sites	
WV DNR estimates that it costs about $4,250/yr to maintain and operate an average application site	
[6 sites @ $4,250/site]	$ 25,500
Left Fork Buckhannon Sites	
[6 sites @ $4,250/site]	$ 25,500
Post-Monitoring (1 year)	
Benthic macroinvertebrate, fish, and limited chemical sampling will cost $800/site/yr.	
[12 sites @ $ 800/site/yr]	$ 9,600
Project 4 Total:	**$ 60,600**

Technical Assistance
WV Division of Natural Resources
Buckhannon River Watershed Association
WV Save Our Streams
WV Division of Water and Wastewater

D.5. Project 5: Implementation of Agriculture Best Management Practices

Fencing	$ 30,000
Critical Area Treatment	$ 15,000
Stream Crossing	$ 12,000
Water Supply	$ 52,331
Roofed Winter Feeding Areas	$160,000
Heavy Use Protection Area	$ 16,000
Roof run-off management	$ 8,000
Buffer and filter Strips	$ 5,000
Animal Waste Storage Facilities	$ 90,000
Habitat Assessment and Biological Monitoring	$ 20,000
Administrative Costs	$ 70,343
Project 5 Total:	**$478,674**

Technical Assistance
WV Conservation Agency
USDA Natural Resource Conservation Service
WV University Extension Service
WV Save Our Streams

D.6. Project 6: Reclamation of Oil and Gas roads

Reclaim 3,000 feet of pipeline heavily used by ATV's by reseeding, regrading, and installing barriers. Cost includes inspection time, dozer hours, and cost of materials [2 pipelines @ $15,000 each].	$ 30,000
Project 6 Total:	**$ 30,000**

Technical Assistance
WV Division of Water and Wastewater
WV Office of Oil and Gas

D.7. Project 7: Coordination and Education

Implementation of Education Projects	$ 6,000
Writing Two Progress Reports	$10,000
Revising the WIP	$ 8,000
Developing hydrologic model	$ 8,000
Project 7 Total:	**$32,000**

Technical Assistance
The Highlands Institute
Buckhannon River Watershed Association
WV Division of Water and Wastewater
Buckhannon Framework Steering Committee

Table 12. Grand total for all seven proposed projects.

	Estimated Costs
Project 1	**$ 790,425**
Project 2	**$ 684,000**
Project 3	**$ 74,600**
Project 4	**$ 60,600**
Project 5	**$ 478,674**
Project 6	**$ 30,000**
Project 7	**$ 32,000**
Grand Total	**$ 2,150,299**

E. Information and Education Component

E.1. Acid Mine Drainage

"Education" is featured prominently in the mission statements of both the Buckhannon River Watershed Association and the Highlands Institute for Environmental Research and Education at WVWC. These two organizations have a history of outreach and education in the local community and make use of a variety of media. The BRWA will keep local citizens informed through its newsletter, pubic forums, and educational displays at regional fairs and festivals. BRWA may also organize volunteer citizen monitoring of some of the AMD projects proposed herein. The Highlands Institute will convene meetings with state, county, and local agencies and facilitate communication among all participants.

E.2. Agriculture

Educating the agricultural community can bring about change. Through educational activities, workshops, and technical assistance landowners will be offered education concerning sediment, water quality, best management practices, as well as their surrounding environment. Technical assistance will be given to landowners who have questions or concerns about their agricultural operation. The Natural Resource Conservation Service and WV Conservation Agency will also promote their cost share programs from which both farmers and the environment can benefit. News releases and brochures will be used as methods to inform the public of upcoming events, and programs that are available to them.

E.3. Forestry

The West Virginia Division of Forestry holds several workshops each year for their staff and for loggers within the state. Workshops are held to certify loggers and timber operators. These workshops are designed to educate loggers and operators about our environment and Best Management Practices to use while harvesting timber. Landowners who use a properly licensed timber operator and a certified logger know the workers will use BMPs that reduce both soil erosion and water pollution.

E.4. Oil and Gas

Educating the public about the risks of using of oil and gas roads and pipelines as ATV roads is critical. Educational workshops, news articles, or demonstration projects to deter riders from these areas are key to their improvement. Similarly roads used by logging operations that are not brought back to oil and gas specifications also pose a problem. An education program used to teach loggers will be implemented in connection with the WV Division of Forestry concerning the use of oil and gas roads as logging roads, and how to bring them back to DEP standards.

F. Schedule of Implementation

Year	Qtr.	Project 1	Project 2	Project 3	Project 4
2004	3rd		obtain funding	design treatment system	obtain funding
	4th				
2005	1st				project installation
	2nd		survey; pre-monitoring	obtain funding	
	3rd	obtain funding			post- monitoring
	4th			project installation	
2006	1st				
	2nd	pre-monitoring; project design	project design		
	3rd				
	4th		project installation	post- monitoring	
2007	1st				
	2nd	project installation			
	3rd				
	4th		post-monitoring		
2008	1st	post-monitoring			
	2nd				
	3rd				
	4th				
2009					

Year	Qtr.	Project 5	Project 6	Project 7
2004	3rd	obtain funding	obtain funding	
	4th			
2005	1st			
	2nd	implement program; install BMPs; pre- and post- monitoring on a per project basis	implement program	Implement Education programs
	3rd			
	4th			Develop hydrologic model
2006	1st			
	2nd			write progress report
	3rd			Implement Education programs
	4th			
2007	1st			
	2nd			Implement Education programs
	3rd			
	4th	final post-monitoring		
2008	1st			
	2nd			write progress report
	3rd			
	4th			
2009				revise WIP

G. Schedule of Interim Milestones

The criteria listed in section H will be evaluated every two years according to the monitoring plan described in section I in a biennial report. These reports will evaluate the progress made by each of the projects.

The first major milestone in the middle of 2006 when all assessment and site identification (Projects 1 and 2) is expected to be completed and the first progress report is written. The second milestone will be the second progress report in 2008 at which time projects 1, 2, and 3 will be complete (except perhaps for some post-monitoring). The success at achieving the targeted load reductions will be evaluated at that point.

The third milestone will occur after 5 years in 2009. At that time the Watershed Implementation Plan Committee will convene to revise the Watershed Implementation Plan. Our objective is to have achieved 25% of our main goals (see section A.1.) within 5 years. That is, achieve load reductions in metals of 25% of our target, improve RHA Index scores by 25%, improve 25% of the impaired stream riparian zones, etc. The two previous progress reports will provide much of the information needed to evaluate progress to date.

H. Criteria to be Used

H.1. Metals

Concentrations and loads of iron, manganese, and aluminum will be used as the criteria. Loads will be calculated using a computer model (see sections I and C.5.) and measured metal concentrations. Compared to the target load reductions from the TMDL, the estimated load reductions for Projects 1, 2, and 3 are 6.1% for iron, 218% for manganese, and 26% for aluminum. Success at achieving these estimated reductions will be determined in 2008. After completion of these projects additional projects will be designed to address the remaining load reductions required for iron and aluminum.

H.2. pH/Acidity

AMD treatment projects proposed in this plan should reduce acidity by 120,182 lbs/yr of acid by 2007. Assessments of those projects will begin in 2006 and continue to 2008 and will determine success. The limestone fines treatment of streams impacted by acid deposition will remove nine streams in the Upper Buckhannon watershed from the 303(d) list by 2008.

H.3. Sediment and Fecal Bacteria

Because it is difficult to measure sediment loads directly, we will make use of indirect measures of sediment. The Rapid Habitat Assessment Index will be used to quantify stream channel and riparian zone quality and locations of BMPs that are installed will be recorded. Bioassessment of benthic macroinvertebrates will be used to supplement the criteria listed above. The WV Stream Condition Index will be used as the criterion for assessment. Values greater than 68% (Good category) are desirable. Streams will be assessed for this criterion in 2008. Fecal bacteria loads will also be tied to the BMPs installed. These practices should reduce or eliminate 1000 tons of manure from entering the streams by 2007. It is predicted that these efforts will restore 24 miles of stream (61% of the impaired stream miles) to water quality

standards. A comprehensive assessment to determine if this goal has been met will be conducted in 2008.

I. Monitoring component

Monitoring is an essential component of a watershed-based implementation plan because it allows stakeholders to see what progress is being made and when goals are achieved. Monitoring will be a key component of each of the projects described in section C above. In general at least one year of chemical monitoring will be conducted before and after each project within the project's subwatershed (see section F). Habitat assessment and bioassessment will be conducted once before and one year after the completion of each project. Chemical sampling will be the responsibility of the organization that is conducting the reclamation. Habitat and bioassessment may be done by the reclaiming organization or by WV Save Our Streams or The Highlands Institute.

In addition to localized, project-related monitoring, watershed-wide surveys of water quality will take place at least every two years and will include all of the criteria listed in section H. These surveys may be conducted by WV DEP, BRWA, or The Highlands Institute. The Highlands Institute will serve as the data repository and will generate a biennial progress report on water quality in the watershed.

J. References

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